

**REMARKS**

By the Office Action of 20 September 2005, Claims 1-20 are pending in the Application, Claimed 18-20 being withdrawn, and Claims 1-17 being rejected. By the present *Response and Amendment*, the Applicant amends Claims 1, 5, 7-9, and 12-15, cancels Claims 18-20, and adds new Claim 21.

No new matter is believed introduced by the present *Response and Amendment*. It is respectfully submitted that the present Application is in condition for allowance for the following reasons.

**1. The Present Invention**

The present invention is related to a single substrate actuator, and the fabrication of same. In particular, the present invention is related to a microfabricated magnetically actuated latching microvalve. *Specification*, ¶ [0003].

***Integrated Circuits***

Microvalve development is closely linked with the research in MEMS actuators. The microvalve is involved in many applications, each requiring different characteristics. Even though millions of dollars have been spent in the research, there has not yet been commercialization of the MEMS microvalve, quite unlike the silicon pressure sensor that has been largely commercialized in many engineering applications, including automobile, fluidic device, and jet propulsion. *Specification*, ¶ [0011].

Prior to the present invention, MEMS valves developed in the research lab were simply not yet reliable and robust enough for commercial application. Prior to the present invention, the state of research in the microvalve field was not well established, nor oriented into a particular application. The research was mainly focused in the state of innovation, where proper application of the valve is not the focus area. This is a main reason why the MEMS valve prior to the present invention has failed to come to the market. *Specification*, ¶ [0012].

Another challenge in bringing MEMS device to market is the need for its compatibility with integrated circuits, namely CMOS compatibility. Currently, there is a big demand for the MEMS actuator to be CMOS compatible so that it can be integrated in the fabrication with other electrical circuit(s). *Specification*, ¶ [0013].

Claim 1 has been clarified, and now recites that the claimed actuator is integrated circuit compatible, in line with amended Claim 13 that recites the actuator is CMOS compatible. None

of the cited references anticipate this innovation as recited in Claim 1, nor is this innovation as recited in Claim 1 obvious in view of the cited reference either alone, or in combination.

While it is respectfully submitted that Cho et al. is not prior art, at least as a §102(b) reference, Cho et al. indeed mentions IC and CMOS concepts, *see first page, column 2*, yet here, Cho et al. is simply discussing the electroplating of the permanent magnet, specifically, that the low temperature plating process disclosed therein is compatible with IC and CMOS substrates, and can therefore allow integration of magnetic materials with the IC and CMOS circuits.

The actuator disclosed in Cho et al. is *not* CMOS compatible, nor is IC and CMOS compatibility mentioned again in the paper. Cho et al. describes the fabrication of a membrane actuator which has arrays of permanent magnets integrated on the membrane that enable the actuator to have bi-directional motion.

The present invention solves the long felt need of providing an IC and CMOS capable actuator, wherein IC and CMOS integration is important for the future products that combine micro actuators together with integrated circuits on a single substrate. This is the invention of Claim 1.

The applications of such a device include both cooling of electronic circuits, and active control for the routing of the fluid flow, which can therefore be achieved at a lower cost batch fabrication process. Other applications include biomedical and bioanalysis where multiple fluid flows are controlled for the purpose of bio and chemical analysis, known as the Lab-on-Chip concept. The integration of the sensor with measurement circuit and the microvalve can result in a small, low cost, device, and benefits in the analytical performance of the bioanalysis system, including more rapid analysis and higher sensitivity.

#### ***Power Consumption***

The prior art designs were also plagued by relatively high power consumption to both operate, and also to latch in the open and closed positions. *See Specification, Table 1.*

Another of the innovative features of the present invention was to provide an actuator that is bistable, with negligible current or power necessary to keep the actuator open or closed. In one embodiment, the present invention is disclosed as including an electromagnetic force generator that can include a coil or coils through which a current is provided, to generate the force, and/or a magnet. Further, the stability of the present membrane to remain in the first

and/or second position can be provided *without* an induced force through the coil(s), making the design a low power consuming design. *Specification*, ¶ [0074] (emphasis added).

This particular limitation was previously provided in Claims 5, 7, 9 and 15. Yet, the Applicant is unable to find a specific reference to this particular novel and non-obvious feature of Claims 5, 7, 9 and 15 mentioned in the *Office Action*.

Applicant respectfully submits the present invention's ability to remain stable without assistance of (prior language) an electromagnetic force from the electromagnetic force generator, or in other words, without an induced force (at no power), in view of the prior art is novel and non-obvious as claimed in Claims 5, 7, 9 and 15. Nonetheless, Applicant clarifies this language, but maintains that none of the art in combination discloses this functionality of the present invention.

Claims 5, 7, 9 and 15 have been clarified, and now recite that the claimed actuator can remain open or closed without an induced electromagnetic force from the electromagnetic force generator (that is, there is negligible current through the generator). None of the cited references anticipate this innovation as recited in Claims 5, 7, 9 and 15, nor is this innovation as recited in Claims 5, 7, 9 and 15 obvious in view of the cited reference either alone, or in combination.

Both Albarda et al. and Biegelsen et al. disclose devices that have membranes that are latched into a stable open or closed position (deflection up or down in the figures) only with power provided to the device, albeit perhaps "reduced" power. The present invention, as recited in Claims 5, 7, 9 and 15, is novel and non-obvious over Albarda et al. and Biegelsen et al. as the present device is stable in both positions with the power turned off.

For example, Biegelsen et al. discloses that there needs to be a sufficient, generated holding force to keep the valve in the stable location. *See Col. 12, Line 48*. The current is reduced, but still applied, when the pre-stressed nature of the membrane keeps it in a stable open or closed position. In the present invention, the device is capable of being bistable with negligible power consumption in both the open and closed positions.

Lastly, new Claim 21 is presented, being in essence a combination of Claim 1-3 and 6-7. It is believe it is novel and non-obvious over the cited art.

## 2. The Claim Rejections

The Examiner rejects Claims 1-20 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claims the subject matter that

Applicant regards as the invention. Applicant thanks the Examiner for the careful review of the Claims, and suggestions of potential language to overcome this ground of rejection. The Claims have been so amended, and this ground of rejection believed overcome.

Claim 1 is rejected under 35 U.S.C. §102(b), as being anticipated by Albarda et al. This ground of rejection is believed overcome by the clarifying amendments to Claim 1, namely that the present actuator is integrated circuit compatible.

Claims 1-7 and 10-17 are rejected under 35 U.S.C. §103(a) as being obvious over Biegelsen et al. in view of Albarda et al.

This ground of rejection is believe overcome in view of the clarifying amendments, as the combination of these references does not teach or suggest, for example, (i) an integrated circuit compliant actuator, nor (ii) an actuator that utilizes an electromagnetic force generator to generate an induced electromagnetic force to manipulate the membrane, but is bistable in the open and closed positions without such induced force, nor (iii) specific to Claim 8, can these references be combined to obviate the invention.

As to Claim 8, respectfully, it is not possible to integrate a 40µm thick magnetic film into the actuator described in Figure 11 of Biegelsen et al. The stiffness of the membrane would be so great that it would prevent the valve membrane from displacing with any reasonable current energized to the coil. Excessive heat dissipation would result due to the ohmic losses in the coil so that it would burn out.

In addition, the membrane may mechanically undergo a plastic deformation and change in shape. This will then not be able to move back to its original position over the flow channel, so that the valve would not function correctly. Finally, such large forces could result in a mechanical failure of the membrane.

As to the rejection of Claims 10-11 and 13, the Examiner asserts an obvious "design choice" rejection. Applicant respectfully submits that the specific energy applied to the actuator, and the time to fully activate, and the process used to form the substrate is repeatedly shown throughout the *Specification* to be anything but merely design choice, as the art is replete is references illustrating that low power, quick response time, and CMOS capability were unreachable prior to the present invention.

In a proper obviousness determination, "whether the changes from the prior art are 'minor', . . . the changes must be evaluated in terms of the whole invention, including whether

the prior art provides any teaching or suggestion to one of ordinary skill in the art to make the changes that would produce the patentee's . . . device." *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 935, 15 U.S.P.Q.2D (BNA) 1321, 1324 (Fed. Cir.), *cert. denied*, 498 U.S. 920, 112 L. Ed. 2d 250, 111 S. Ct. 296 (1990). This includes what could be characterized as simple changes, as in *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. (BNA) 1125, 1127 (Fed. Cir. 1984) (Although a prior art device could have been turned upside down, that did not make the modification obvious unless the prior art fairly suggested the desirability of turning the device upside down.).

Applicant admits that "[w]here the prior art gives reason or motivation to make the claimed [invention] . . . the burden (and opportunity) then falls on an applicant to rebut that *prima facie* case" *In re Dillon*, 919 F.2d 688, 692-93, 16 U.S.P.Q.2D (BNA) 1897, 1901 (Fed. Cir. 1990) (in banc), *cert. denied*, 500 U.S. 904, 114 L. Ed. 2d 77, 111 S. Ct. 1682 (1991), but respectfully submits the *prima facie* case has not been made here.

Applicant, throughout the *Specification*, provides multiple reasons why a low power actuator is not merely a matter of "design choice." Similarly, the *Specification* notes with specificity that the claimed power, response time, and fabrication process are novel and non-obvious. None of the cited art provides motivation to provide what the Applicant claims herein.

Applicant's disclosure regarding these limitations of Claims 10-11 and 13 militate against a conclusion that they are obvious design choices. See *In re Gal*, 980 F.2d 717, 25 U.S.P.Q.2D (BNA) 1076 (Fed. Cir. 1992) (finding of "obvious design choice" precluded where the claimed structure and the function it performs are different from the prior art).

Claims 8-9 and 14-17 are rejected under 35 U.S.C. §103(a) as being obvious over Biegelsen et al. in view of Cho et al. It is respectfully submitted that Cho et al. is not prior art against the present invention, wherein the application has an effective filing date of November 2002, and the Cho et al. reference has a publication date less than one year prior to the effective filing date. Should the Cho et al. reference be used by the Examiner in a §102(a) sense in a subsequent *Office Action*, Applicant intends to swear behind it, providing an earlier invention date.

Nonetheless, as described above, this combination of references is believed overcome by the clarifying amendments herein.

### 3. Fees

No Claim fees are believed due. The number of Claims pending remains less than those filed.

No extension of time fees are believed due. This *Response and Amendment* is being filed within six months of the *Office Action*, and more specifically within three months.

Nonetheless, should any fees be due, authorization to charge deposit account No. 20-1507 is hereby given.

### CONCLUSION

By the present *Response and Amendment*, the Application has been in placed in full condition for allowance. Accordingly, Applicant respectfully requests early and favorable action. Should the Examiner have any further questions or reservations, the Examiner is invited to telephone the undersigned Attorney at 404.885.2773.

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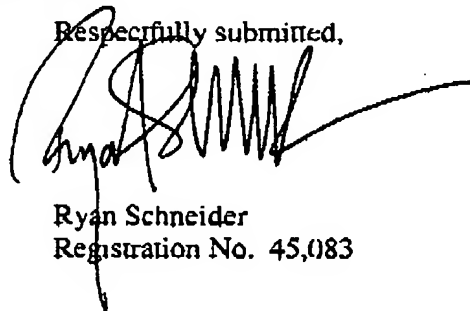
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Respectfully submitted,



Ryan Schneider

Registration No. 45,083

Troutman Sanders LLP  
Bank of America Plaza  
600 Peachtree Street, N.E., Suite 5200  
Atlanta, Georgia 30308-2216  
United States  
Phone: 404.885.2773  
Fax: 404.962.6849

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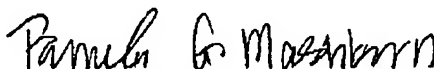
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